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TI - DIELECTRIC MULTILAYER SUBSTRATE, MICROWAVE AND/OR MILLIWAVE FILTER AND PRODUCTION THEREOF

AB - PROBLEM TO BE SOLVED: To facilitate production by making mutually different the refractive index of mutually adjacent two dielectric layers at least among plural dielectric layers, respectively providing both mutually practically parallel main surfaces on the respective plural dielectric layers and mutually laminating both the main surfaces each other.

- SOLUTION: On a dielectric substrate 25 having dielectric constant &epsi r2 , refractive index N2 and thickness t2 , a dielectric substrate 14 having dielectric constant &epsi r1 , refractive index N1 and thickness t1 is laminated and on that substrate 14, a dielectric substrate 14 having dielectric constant &epsi r2 , refractive index N2 and thickness t2 is laminated. On that substrate 14, dielectric substrates 14 and 24 are alternately laminated. No conductor is included in the dielectric substrates 14, 24 and 25 and no conductor is included among the dielectric substrates 14, 24 and 25, either. Thus, a dielectric multilayer substrate can be easily produced without providing any slit requesting high working accuracy and a filter for selectively transmitting or reflecting the electromagnetic waves of wide frequency bands can be easily produced.

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PA - SUMITOMO METAL IND LTD

IN - KIKUYAMA HIROSHI;TSUKIYAMA YOSHIO;MIZUNO KOJI;PEI SHIYOUSEKI

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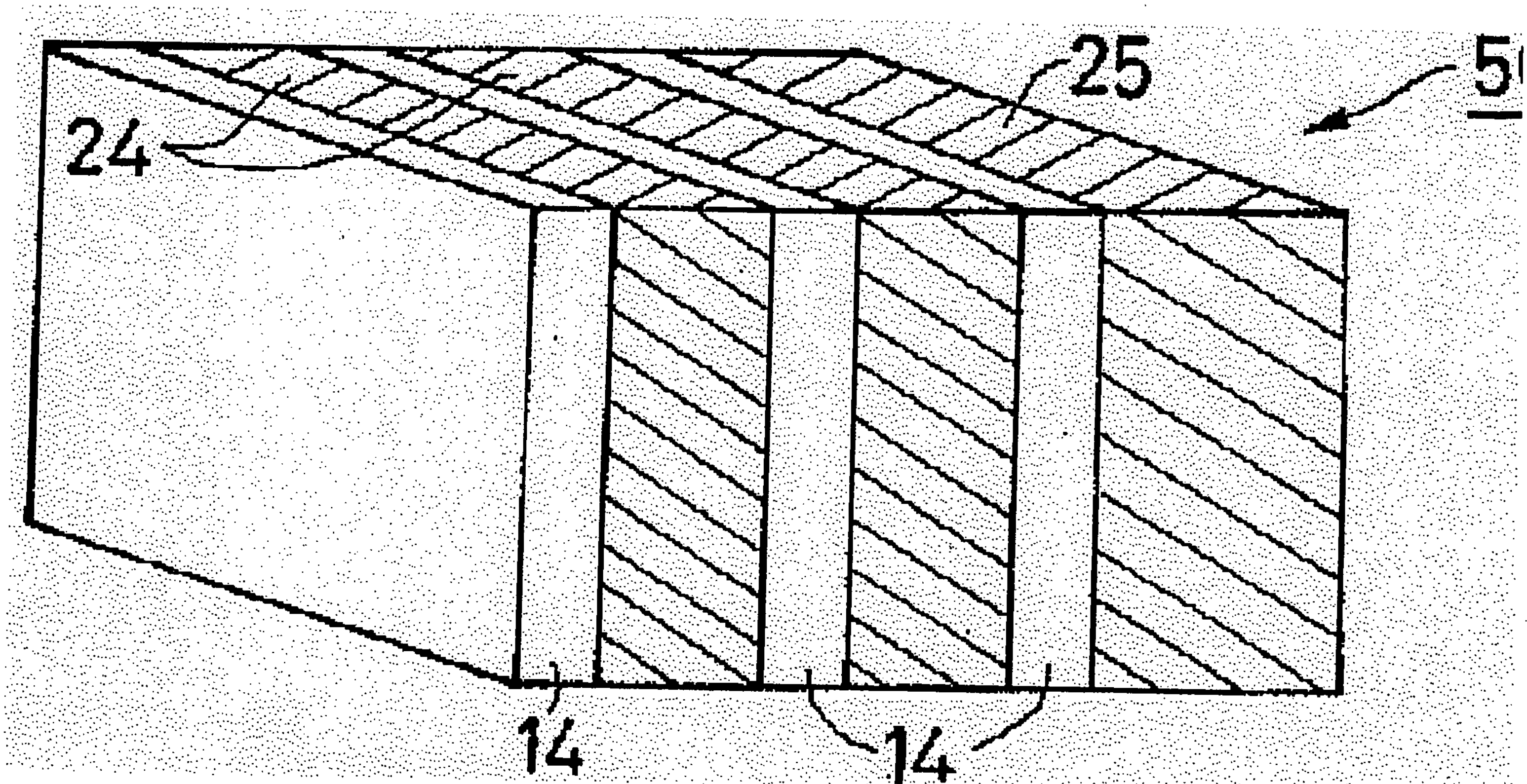
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* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to the short circuit machine (short plunger) used for the filter row for a dielectric multilayer substrate, microwave, and/or millimeter waves about those manufacture methods with a microwave band (frequency : 3-30GHz) or a millimeter wave band (frequency : 30-300GHz), and its manufacture method.
[0002]
[Description of the Prior Art] In the microwave band or the millimeter wave band, a waveguide, a microstrip line, KOPURENARA in, the coaxial track, etc. are usually used abundantly as the transmission line of an electromagnetic wave.
[0003] In order that, as for a waveguide, an electromagnetic wave may spread a closed space compared with an opening type track also especially in this, it is suitable for transmission of low loss and large power. Therefore, it is used abundantly as a part of microwave, millimeter wave transceiver system, or a feeder-wire way for antennas.
[0004] Conventionally, drawing 7 and the adjustable short circuit machine (short plunger) shown in 8 are used abundantly as an element which short-circuits the termination of a track by changing track length in such a waveguide. When using such an adjustable short circuit machine, in order to give the movability within a waveguide, some opening is prepared in the wall of an adjustable short circuit machine and a waveguide. Existence of an opening causes [of an electromagnetic wave] transparency (disclosure) as a result. then, the slot (slit) 82 which is 1/4 of the wavelength of the electromagnetic wave on which the width of face spreads the inside of a waveguide 83 as shown in drawing 7 and 8 -- the front face of the adjustable short circuit machine 80 -- **** -- things constituting lambda/4 transformer and changing the characteristic impedance in a waveguide 83 -- electric -- simplistic -- a near state is made and transparency (disclosure) of an electromagnetic wave is suppressed It comes to be shown in drawing 9 and the equal circuit of this adjustable short circuit machine is wavelength lambdag. Zin is almost set to 0 to an electromagnetic wave.
[0005]
[Problem(s) to be Solved by the Invention] However, this invention persons found out that the following trouble mainly existed in the above-mentioned conventional technology.
[0006] That is, naturally, the width of face of a slit 82 also becomes small, and a very high process tolerance comes to be required, so that the frequency of an electromagnetic wave becomes high (so that wavelength becomes short). for example, the case where the frequency of an electromagnetic wave is 100GHz -- lambda/4 -- 0.75mm -- becoming -- **-- a dozens of micrometers process tolerance is required Therefore, the manufacturing cost of a short circuit machine rises, so that frequency becomes high.
[0007] It sets it as the main purposes that this invention provides with those manufacture methods the filter row for a dielectric multilayer substrate, microwave, and/or millimeter waves which was made in view of the above point, does not need to prepare the slit as which a very high process tolerance is required, and can be manufactured easily.
[0008]
[Means for Solving the Problem] First, the principle of this invention which this inventions thought out is explained.

[0009] Suppose that the dielectric substrate 2 with very high parallelism of specific-inductive-capacity epsilonr (square value of a refractive index n) without loss and thickness t is placed into the medium 1 of refractive-index n'. As shown in drawing 1 , as for theta, then path-difference deltaL between the partial waves A1 and A2 of a plane wave, an electromagnetic wave (plane wave) can express the angle of refraction in the dielectric substrate 2 with the dielectric substrate 2 by the formula (1) by incident angle theta' from a medium 1, when incidence is carried out. Namely, [Equation 1] deltaL=n(AC+CE)-n'AB [0010] Here, since it is equal, the optical path length between wave fronts AD and BE is [Equation 2]. nDE=n'AB [0011] Therefore, [Equation 3]
deltaL=n (AC+CD)
= n [t{cos(2theta)/costheta}+ (t/costheta)]
= 2ntcostheta ... (1)
[0012] Therefore, it is the wavelength in the vacuum of an incident wave lambda 0 Then, the phase contrast delta over a formula (1) can be expressed with a formula (2).
[0013]
[Equation 4]
delta=(2pideltaL)/lambda0 =4pint(costheta)/lambda0 ... (2)
[0014] Moreover, the intensity ratio (permeability) T of the electromagnetic wave which carries out incidence to the intensity and the dielectric substrate 2 of the electromagnetic wave which penetrates the dielectric substrate 2 is expressed with a formula (3).
[0015]
[Equation 5]
T= 1/{1+Csin2 (delta/2)} ... (3)
[0016] Here, it is C=4R/(1-R)2, and C is contrast and R is an on-the-strength reflection factor.
[0017] At the time of 2mpi (m is arbitrary integers), delta is set to 1 of maximum and permeability is frequency fm about this condition. It is c0 when shown. A formula (4) is obtained as high-speed [in a vacuum].
[0018]
[Equation 6]
fm =mc0/(2ntcostheta) ... (4)
[0019] That is, if a refractive index n, thickness [of a substrate] t, and an incident angle theta are given, the frequency (resonance frequency) from which permeability serves as the maximum will be determined. Mutual interval deltafm of resonance frequency Formula (5)
[Equation 7]
deltafm =fm+1-fm =c0/(2ntcostheta) ... (5)
It is come out and expressed.
[0020] Moreover, it is c0, when permeability serves as the minimum value (a reflection factor serving as maximum) and delta shows this condition by frequency fm' at the time of pi (2m+1) (m is arbitrary integers). A formula (6) is obtained as high-speed [in a vacuum].
[0021]
[Equation 8]
fm'=(2m+1) c0/(4ntcostheta) ... (6)
[0022] That is, if a refractive index n, thickness [of a substrate] t, and an incident angle theta are given, the frequency from which permeability serves as the minimum (a reflection factor serves as the maximum) will be determined.
[0023] Furthermore, considering the case of vertical incidence (theta= 0), a formula (4) and (5) are [Equation 9], respectively.
fm =mc0 / (2ntcostheta) =mc0/(2nt) ... (7)
deltafm =fm+1-fm =c0/(2nt) ... (8)
A next door and a formula (6) are [Equation 10].
fm'=(2m+1) c0/(4nt) ... (9)
It becomes.
[0024] Here, it is [Equation 11] from a formula (9).
fm' =2mc0 /(4nt)+c0 /(4nt)
= mc0 / (2nt) + {(1/2)xc0} /(2nt)

= fm+1/2deltafm ... (10)
It becomes.

[0025] The frequency (frequency from which a reflection factor serves as the maximum) to which permeability serves as the minimum from this exists in the center between the adjacent frequency from which permeability serves as the maximum. Therefore, the transparency property of an electromagnetic wave becomes like drawing 2 .

[0026] Here, it is [Equation 12] from a formula (9).
nt=(2m+1) x(1/4) xc0/fm'=(2m+1) x(1/4) lambda0 ... (11)

[0027] That is, when the product of a refractive index n and thickness t of a substrate is doubled one fourth of odd times of the wavelength of the electromagnetic wave which carries out incidence, the minimum understands permeability and the maximum and a bird clapper understand a reflection factor.

[0028] Although it is explanation of an about when the dielectric substrate 2 is placed into the medium 1 of refractive-index n', the above is the same when two or more dielectric substrates have been arranged so that refractive indexes may differ mutually between [adjoining] dielectric substrates.

[0029] namely, each refractive index nq (q= -- 1 and 2 ...) of the dielectric substrate of plurality (p pieces) product nq-tq of p) and each thickness tq (1 q= two ..., p) -- twice [respectively / (lambda 0 / 4)] (2m+1) (m is arbitrary integers) -- then To the electromagnetic wave of frequency c0/lambda0, the minimum, i.e., a reflection factor, serves as the maximum, and, as for permeability, the minimum, i.e., a reflection factor, serves as [permeability] the maximum from a formula (9) and a formula (11) in each of two or more dielectric substrates. And since the laminating of the dielectric substrate of two or more layers is carried out, the frequency band from which a reflection factor becomes large compared with a monolayer, and a reflection factor is set to 1 closely becomes large in connection with it. Therefore, a reflection factor can be made into the maximum (it is the minimum about permeability) over a wide band a center [the electromagnetic wave of frequency c0/lambda0].

[0030] On the other hand, in the above-mentioned conventional short circuit machine 80, since the width of face of a slit 82 is being fixed, to the electromagnetic wave which becomes effective only in the electromagnetic wave of a certain specific frequency (single frequency), and has wide band width of face, it is unsuitable as a short circuit machine.

[0031] Thus, compared with the short circuit machine produced by the conventional machining, by using a dielectric multilayer substrate, a reflection factor can be far made into the maximum (about 1) over a wide band, and the short circuit machine (short plunger) which has the function of the band elimination filter (BRF:band rejection filter) which reflects the electromagnetic wave of a desired frequency band alternatively can be obtained.

[0032] Moreover, when using a dielectric multilayer substrate as such a short circuit machine, it becomes unnecessary to prepare the slit which needs a high process tolerance like before, and can manufacture by the low cost as compared with the conventional short circuit machine.

[0033] Moreover, on the other hand, it is [Equation 13] from a formula (7).
nt=(m/2) xc0/fm=mx1/(2lambda0) ... (12)

[0034] That is, when the product of a refractive index n and thickness t of a substrate is doubled with one half of the integral multiples of the wavelength of the electromagnetic wave which carries out incidence, the maximum and a bird clapper understand permeability.

[0035] Therefore, by shifting product nq-tq of each refractive index nq (1 q= two ..., p) and each thickness tq (1 q= two ..., p) of the dielectric substrate of plurality (p pieces) little by little, respectively From the ability of the frequency from which permeability serves as the maximum to be shifted little by little, respectively, the function of the band-pass filter (BPF : band pass filter) which penetrates the electromagnetic wave of a desired frequency band alternatively can also be obtained.

[0036] In addition, in order to have the above properties, it is desirable that a conductor does not exist in each dielectric substrate which constitutes a dielectric multilayer substrate, and a conductor does not exist between dielectric multilayer substrates.

[0037] Moreover, the aforementioned dielectric layers which adjoin mutually may stick and the interlayer who consists of an air space or a dielectric layer may exist between the aforementioned

dielectric layers which adjoin mutually. However, it is desirable that product n-t of this interlayer's refractive index n and the thickness in the aforementioned laminating direction is or less about 1 of the wavelength of the microwave which carries out incidence to a dielectric multilayer substrate, or a millimeter wave / 40. It is because product n-t of a refractive index n and thickness will become very small and will hardly affect the filter shape as a short circuit machine etc., even if the interlayer exists, if it does in this way. Moreover, as for an interlayer's refractive index, it is desirable that it is smaller than 3. And if adhesives are used as this interlayer, the aforementioned dielectric layers which adjoin mutually can be pasted up.

[0038] this invention is made based on this principle and knowledge, and according to the claim 1 Two or more dielectric layers are the dielectric multilayer substrates by which the laminating was carried out, and the refractive indexes of at least two aforementioned dielectric layers which adjoin mutually among two or more aforementioned dielectric layers differ mutually. Each of two or more aforementioned dielectric layers has both parallel principal planes substantially mutually, respectively. The dielectric multilayer substrate which the laminating of two or more aforementioned dielectric layers is carried out so that both the aforementioned principal planes may become parallel mutually substantially in between [aforementioned / two or more] dielectric layers, and is characterized by not preparing the conductor between the aforementioned dielectric layers in the aforementioned dielectric layer is offered.

[0039] This dielectric multilayer substrate can be effectively used as a filter for microwave and/or millimeter waves. Moreover, since it is the structure which carried out the laminating of the dielectric layer, the manufacture is also easy.

[0040] Moreover, according to the claim 2, the dielectric multilayer substrate according to claim 1 characterized by the refractive indexes of two or more aforementioned dielectric layers differing between [which adjoins mutually] dielectric layers is offered.

[0041] Moreover, according to the claim 3, the dielectric multilayer substrate according to claim 2 characterized by carrying out the laminating of the dielectric layer which consists of one dielectric materials among the dielectric materials which are two from which a refractive index differs mutually, and the dielectric layer which consists of dielectric materials of another side by turns is offered.

[0042] Moreover, according to the claim 4, it sets to each of two or more aforementioned dielectric layers, and is the distance t1 between both the aforementioned principal planes. Refractive index n1 of the dielectric materials which constitute the aforementioned dielectric layer The dielectric multilayer substrate according to claim 1 to 3 characterized by a product n1 and t1 having the 1st predetermined value about odd times the value of being common, respectively is offered.

[0043] Moreover, according to the claim 5, the dielectric multilayer substrate according to claim 4 characterized by the 1st common value predetermined [aforementioned] being 1/4 of the wavelength of the microwave which carries out incidence to the aforementioned dielectric multilayer substrate, or a millimeter wave is offered.

[0044] The 1st common predetermined value is 1/4 of the wavelength of the microwave which carries out incidence to a dielectric multilayer substrate, or a millimeter wave, and a dielectric multilayer substrate functions as a short circuit machine.

[0045] moreover -- according to a claim 6 -- distance t2 of two or more aforementioned dielectric layers and between both at least one aforementioned principal plane of a dielectric layer the above-- refractive index n2 of the dielectric materials which constitute one dielectric layer even if few A product n2 and t2 the 1st predetermined value -- almost -- the value of an integral multiple -- having -- distance t3 of two or more aforementioned dielectric layers and between both the aforementioned principal planes of other at least one dielectric layer Refractive index n3 of the dielectric materials which constitute at least one dielectric layer besides the above A product n3 and t3 The dielectric multilayer substrate according to claim 1 to 3 characterized by the thing of the 2nd different predetermined value from the 1st value of the above for which it has the value of an integral multiple mostly is offered.

[0046] If this dielectric multilayer substrate is used, the filter which combined at least two filters which have a different property will be obtained. Consequently, a filter equipped with various properties is obtained and the flexibility of a design increases.

[0047] Moreover, according to the claim 7, the 1st predetermined value of the above is a value which is the 3rd predetermined value and applied the 3rd value smaller than one half of the values of the aforementioned wavelength of the above to one half of the values of the wavelength of the microwave which carries out incidence to the aforementioned dielectric multilayer substrate, or a millimeter wave. The dielectric multilayer substrate according to claim 6 characterized by being the value from which the 2nd predetermined value of the above subtracted a value to one half of the 3rd values of the above of the aforementioned wavelength is offered.
[0048] If this dielectric multilayer substrate is used, the band pass filter which has desired bandwidth will be obtained.
[0049] Moreover, according to the claim 8, the dielectric multilayer substrate according to claim 1 to 7 characterized by the aforementioned dielectric layers which adjoin mutually having stuck is offered.
[0050] Moreover, according to the claim 9, between the aforementioned dielectric layers which adjoin mutually, the dielectric multilayer substrate according to claim 1 to 7 characterized by the layer which consists of adhesives existing is offered.
[0051] Moreover, according to the claim 10, between the aforementioned dielectric layers which adjoin mutually, the interlayer who consists of an air space or a dielectric layer exists. The aforementioned interlayer's refractive index n4 The aforementioned interlayer's thickness t4 in the aforementioned laminating direction A product n4 and t4 Either [the claim 1 characterized by being or less about 1 of the wavelength of the microwave which carries out incidence to the aforementioned dielectric multilayer substrate, or a millimeter wave / 40, or] 7 and 9 are provided with the dielectric multilayer substrate of a publication.
[0052] Even if the interlayer of such thickness exists between dielectric layers, it is an interlayer's refractive index n4 and thickness t4. Since a product n4 and t4 are small compared with wavelength, when a dielectric multilayer substrate is used as a filter, a filter shape is hardly affected. In addition, as this interlayer, adhesives are used preferably.
[0053] Moreover, according to the claim 11, it is a filter for microwave and/or millimeter waves equipped with the dielectric multilayer substrate to which the laminating of two or more dielectric layers was carried out. The refractive indexes of at least two aforementioned dielectric layers which adjoin mutually among two or more aforementioned dielectric layers differ mutually. Each of two or more aforementioned dielectric layers has both parallel principal planes substantially mutually, respectively. The filter for microwave and/or millimeter waves characterized by carrying out the laminating of two or more aforementioned dielectric layers so that both the aforementioned principal planes may become parallel mutually substantially in between [aforementioned / two or more] dielectric layers is offered.
[0054] Since this dielectric multilayer substrate is the structure which carried out the laminating of the dielectric layer, the manufacture is also easy for it.
[0055] Moreover, according to the claim 12, the microwave according to claim 11 and/or the filter for millimeter waves which are characterized by not preparing the conductor between the aforementioned dielectric layers in the aforementioned dielectric layer are offered.
[0056] Moreover, according to the claim 13, the microwave according to claim 11 or 12 and/or the filter for millimeter waves which are characterized by the refractive indexes of two or more aforementioned dielectric layers differing between [which adjoins mutually] dielectric layers are offered.
[0057] Moreover, according to the claim 14, the microwave according to claim 11 to 13 and/or the filter for millimeter waves which are characterized by carrying out the laminating of the dielectric layer which consists of one dielectric materials among the dielectric materials which are two from which a refractive index differs mutually, and the dielectric layer which consists of dielectric materials of another side by turns are offered.
[0058] Moreover, according to the claim 15, it sets to each of two or more aforementioned dielectric layers, and is the distance t5 between both the aforementioned principal planes. Refractive index n5 of the dielectric materials which constitute the aforementioned dielectric layer The microwave according to claim 11 to 14 and/or the filter for millimeter waves which are characterized by a product n5 and t5 having the 2nd predetermined value about odd times the value of being common,

respectively are offered.
[0059] Moreover, according to the claim 16, the microwave according to claim 15 and/or the filter for millimeter waves which are characterized by the 2nd common value predetermined [aforementioned] being 1/4 of the wavelength of the microwave which carries out incidence to the aforementioned dielectric multilayer substrate, or a millimeter wave are offered.
[0060] The 2nd common predetermined value is 1/4 of the wavelength of the microwave which carries out incidence to a dielectric multilayer substrate, or a millimeter wave, and this filter functions as a short circuit machine.
[0061] Moreover, according to the claim 17, the microwave according to claim 11 to 16 and/or the filter for millimeter waves which are characterized by the filter for the aforementioned microwave and/or millimeter waves being a short circuit machine for microwave and/or millimeter waves are offered.
[0062] Thus, the filter for microwave and/or millimeter waves of this invention using the dielectric multilayer substrate is preferably used as a short circuit machine and a short circuit machine (short plunger) which has the function of the band elimination filter (BRF:band rejection filter) which reflects the electromagnetic wave of a desired frequency band alternatively especially.
[0063] Moreover, according to the claim 18, it sets to each of two or more aforementioned dielectric layers, and is the distance t5 between both the aforementioned principal planes. Refractive index n5 of the dielectric materials which constitute the aforementioned dielectric layer The microwave according to claim 17 and/or the filter for millimeter waves which are characterized by a product n5 and t5 being about odd times [one fourth of] the wavelength of the microwave reflected by the aforementioned short circuit machine or a millimeter wave are offered.
[0064] moreover -- according to a claim 19 -- distance t6 of two or more aforementioned dielectric layers and between both at least one aforementioned principal plane of a dielectric layer the above-- refractive index n6 of the dielectric materials which constitute one dielectric layer even if few A product n6 and t6 the 4th predetermined value -- almost -- the value of an integral multiple -- having -- distance t7 of two or more aforementioned dielectric layers and between both the aforementioned principal planes of other at least one dielectric layer Refractive index n7 of the dielectric materials which constitute at least one dielectric layer besides the above A product n7 and t7 The microwave according to claim 11 to 14 and/or the filter for millimeter waves which are characterized by the thing of the 5th different predetermined value from the 4th value of the above for which it has the value of an integral multiple mostly are offered.
[0065] Since this filter turns into a filter which combined at least two filters which have a different property, it can change the filter shape variously and the flexibility of a design increases it.
[0066] Moreover, according to the claim 20, the 4th predetermined value of the above is a value which is the 6th predetermined value and applied the 6th value smaller than one half of the values of the aforementioned wavelength of the above to one half of the values of the wavelength of the microwave which carries out incidence to the aforementioned dielectric multilayer substrate, or a millimeter wave. The microwave according to claim 19 and/or the filter for millimeter waves which are characterized by being the value from which the 5th predetermined value of the above subtracted a value to one half of the 6th values of the above of the aforementioned wavelength are offered.
[0067] If it does in this way, the band pass filter which has desired bandwidth will be obtained.
[0068] Moreover, according to the claim 21, the microwave according to claim 11 to 20 and/or the filter for millimeter waves which are characterized by the aforementioned dielectric layers which adjoin mutually having stuck are offered.
[0069] Moreover, according to the claim 22, between the aforementioned dielectric layers which adjoin mutually, the microwave according to claim 11 to 20 and/or the filter for millimeter waves which are characterized by the layer which consists of adhesives existing are offered.
[0070] Moreover, according to the claim 23, between the aforementioned dielectric layers which adjoin mutually, the interlayer who consists of an air space or a dielectric layer exists. The aforementioned interlayer's refractive index n8 The aforementioned interlayer's thickness t8 in the aforementioned laminating direction A product n8 and t8 Either [the claim 11 characterized by being or less about 1 of the wavelength of the microwave which carries out incidence to the aforementioned dielectric multilayer substrate, or a millimeter wave / 40, or] 20 and 22 are provided

with the filter for microwave and/or millimeter waves of a publication. In addition, as this interlayer, adhesives are used preferably.

[0071] Even if the interlayer of such thickness exists between dielectric layers, it is an interlayer's refractive index n4 and thickness t4. Since a product n4 and t4 are small compared with wavelength, a filter shape is hardly affected. In addition, as this interlayer, adhesives are used preferably.

[0072] Moreover, according to the claim 24, it is the transmission line equipped with microwave according to claim 16, 18, 20, or 23 and/or the filter for millimeter waves, and the transmission line characterized by being the wavelength of the microwave to which the wavelength of the microwave reflected by the wavelength or the aforementioned short circuit machine of the microwave which carries out incidence to the aforementioned dielectric multilayer substrate, or a millimeter wave, or a millimeter wave is transmitted in the aforementioned transmission line, or a millimeter wave is offered.

[0073] moreover, according to the claim 25, from two or more aforementioned sintered compacts which are two or more sintered compacts, consist of two or more dielectric materials which have a mutually different refractive index, respectively, respectively, and do not contain a conductor inside The process at which it is two or more dielectric substrates, and each principal plane of both creates two or more parallel aforementioned dielectric substrates of each other while having predetermined thickness, respectively, The manufacture method of the dielectric multilayer substrate characterized by having the process which sticks two or more aforementioned dielectric substrates with the adhesives which consist of an insulator is offered without including a conductor among two or more aforementioned dielectric substrates.

[0074] moreover, according to the claim 26, from two or more aforementioned sintered compacts which are two or more sintered compacts, consist of two or more dielectric materials which have a mutually different refractive index, respectively, respectively, and do not contain a conductor inside The process at which it is two or more dielectric substrates, and each principal plane of both creates two or more parallel aforementioned dielectric substrates of each other while having predetermined thickness, respectively, The manufacture method of the microwave characterized by having the process which sticks two or more aforementioned dielectric substrates with the adhesives which consist of an insulator, and creates a dielectric multilayer substrate, and/or the filter for millimeter waves is offered without including a conductor among two or more aforementioned dielectric substrates.

[0075] Moreover, the process which creates two or more raw sheets which used two or more aforementioned dielectric materials which are two or more dielectric materials which have a mutually different refractive index, respectively according to the claim 27, and do not contain a conductor, respectively, The manufacture method of the dielectric multilayer substrate characterized by having the process which carries out the laminating of two or more aforementioned raw sheets in predetermined sequence, and creates a layered product, and the process which sinters the aforementioned layered product is offered without including a conductor among two or more aforementioned raw sheets.

[0076] Moreover, the process which creates two or more raw sheets which used two or more aforementioned dielectric materials which are two or more dielectric materials which have a mutually different refractive index, respectively according to the claim 28, and do not contain a conductor, respectively, The process which carries out the laminating of two or more aforementioned raw sheets in predetermined sequence, and creates a layered product, without including a conductor among two or more aforementioned raw sheets, The manufacture method of the microwave characterized by having the process which sinters the aforementioned layered product and creates a dielectric multilayer substrate, and/or the filter for millimeter waves is offered.

[0077]

[Embodiments of the Invention] Next, the gestalt of operation of this invention is explained with reference to a drawing.

[0078] Drawing 3 is an outline perspective diagram for explaining the short circuit machine 50 of the gestalt of 1 operation of this invention. For epsilonr2 and a refractive index, n2 and thickness are [specific inductive capacity] t3. For epsilonr1 and a refractive index, n1 and thickness are [specific inductive capacity] t1 on the dielectric substrate 25. The laminating of the dielectric substrate 14 is

carried out, and, for epsilonr2 and a refractive index, n2 and thickness are t2 on it. The laminating of the dielectric substrate 24 is carried out, and the laminating of the dielectric substrate 14 and the dielectric substrate 24 is carried out by turns on

[0079] A conductor is not contained in the dielectric substrates 14 and 24 and 25, and the conductor is not contained between the dielectric substrates 14 and 24 and 25.

[0080] The dielectric substrates 14 and 24 and between 25 are stuck with adhesives (not shown). As adhesives, it is dielectric constant epsilonr <5, the low dielectric constant of Q> 5000 (at, 1GHz), and the thing of a low loss, for example, and a thing with a thickness of dozens of micrometers or less is desirable.

[0081] Next, with reference to drawing 4 , the manufacture method of the short circuit machine 50 of the gestalt this operation is explained.

[0082] Here, it explains taking the case of the case where dielectric ceramics are used as a material of the dielectric substrates 14, 24, and 25.

[0083] First, the raw material fine particles 11 and 21 of two kinds of dielectric substrates (ceramic substrate) (25) 14 and 24 are corned by the spray dryer etc. (process 1).

[0084] Next, they are cast in the shape of a block with a hydraulic press etc., respectively, and Plastic solids 12 and 22 are created (process 2).

[0085] Next, the block of these Plastic solids 12 and 22 is calcinated in the atmosphere through a ** binder process, and let them be the precise sintered compacts 13 and 23 (process 3).

[0086] Next, these sintered compacts 13 and 23 are sliced to a tabular, it grinds so that it may become desired thickness further, and the dielectric substrates (ceramic substrate) 14, 24, and 25 are created (process 4).

[0087] Next, adhesives are uniformly applied on the front face of the dielectric substrates 14, 24, and 25 using a spin coater etc., and the laminating of each dielectric substrate 14 and 24 (25) is carried out further alternately (process 5).

[0088] Next, pressurizing perpendicularly to a substrate front face by weight 40 grade, in order to raise the adhesion between substrates, adhesives are dried enough and the dielectric multilayer substrate 30 is obtained (process 6). Thus, the obtained dielectric multilayer substrate 30 can be used as a short circuit machine 50.

[0089] In addition, although the method of starting from the sintered dielectric blocks 13 and 23 as the manufacture method of the dielectric multilayer substrate 30 was shown with the gestalt of this operation, what is necessary is just the method of carrying out the laminating of two or more dielectric layers which have the refractive index of either of at least two refractive indexes which are different while having thickness not only this but respectively fixed as the manufacture method of a dielectric multilayer substrate, respectively in predetermined sequence. For example, the raw sheet of predetermined thickness may be prepared per two or more dielectric materials, and a dielectric multilayer substrate may be formed by [which carried out the laminating to predetermined order, respectively] carrying out back simultaneous baking. in this case, although the combination of the dielectric materials which can carry out simultaneous baking will be restricted, according to the method of starting a dielectric substrate from the manufacture method of the gestalt this above-mentioned operation, i.e., the sintered dielectric block, and sticking these after that, the width of face of the selection of dielectric materials by which a laminating is carried out is boiled markedly, and becomes large

[0090]

[Example] Next, the short circuit machine formed using two kinds of dielectric ceramics as one example of this invention is shown.

[0091] The short circuit machine 50 of this example has the structure shown in drawing 3 , and is specific-inductive-capacity epsilonr. For 4.59 and thickness t, 21.5 and a refractive index n are specific-inductive-capacity epsilonr on the dielectric substrate 25 it is [substrate] 1630 micrometers. The laminating of 117 and the dielectric substrate 14 10.59 and whose thickness t a refractive index n is 140 micrometers is carried out. It is specific-inductive-capacity epsilonr on it. The laminating of 21.5 and the dielectric substrate 24 4.59 and whose thickness t a refractive index n is 330 micrometers is carried out, and the laminating of the dielectric substrate 14, the dielectric substrate 24, and the dielectric substrate 14 is carried out by turns in this sequence on it.

[0092] It is the wavelength of the millimeter wave (50GHz) which the refractive index n of a dielectric layer 14 is 10.59, and thickness t is 140 micrometers, and refractive-index x thickness is set to 1.5mm, and carries out incidence lambda 1 If it carries out, it is its lambda1 / 4. It is the wavelength of the millimeter wave which carries out incidence too by the refractive index n of a dielectric layer 24 being 4.59, and thickness t's being 330 micrometers, and setting refractive-index x thickness to 1.5mm lambda 1 If it carries out, it is its lambda1 / 4. Moreover, it is the wavelength of the millimeter wave which the refractive index n of a dielectric layer 25 is 4.59, thickness t is 1630 micrometers, and refractive-index x thickness is set to 7.5mm, and carries out incidence lambda 1 If it carries out, it is the twice (2m+1) (it is m= 2 in this case) lambda1 / 4. In addition, although the thing with the thickness of a dielectric layer 25 thick in this way is for mechanical maintenance of the short circuit machine 50, since refractive-index x thickness is twice (2m+1) (m= 0, 1, 2 ...) lambda1 / 4 even if it is the case where it thickens in this way, it has collectively the function to reflect the millimeter wave which carries out incidence, and a reflection factor serves as the maximum as a short circuit machine.
[0093] A conductor is not contained in the dielectric substrates 14 and 24 and 25, and the conductor is not contained between the dielectric substrates 14 and 24 and 25.
[0094] The dielectric substrates 14 and 24 and between 25 are stuck with adhesives (not shown). As adhesives, epoxy system adhesives are used and it is dielectric constant epsilonr. 4 and the refractive index n were 2, Q (at 1GHz) was 3000, and thickness was 12 micrometers. Thus, thickness is thin, and n is small, therefore refractive-index x thickness is very as small as 24 micrometers, and since the adhesives of a low loss are moreover used, the frequency characteristic of the permeability of the short circuit machine 50 is hardly affected.
[0095] In addition, this short circuit machine 50 was manufactured by the manufacture method of the gestalt the 1 above-mentioned implementation explained with reference to drawing 4.
[0096] This short circuit machine 50 was formed in the waveguide 60, and the reflection property (transparency property) of the electromagnetic wave in a 30-70GHz band was measured according to the system of measurement of drawing 5 using the network analyzer (H.P.8510C) 70. A solid line shows a result to drawing 6 . In 40-60GHz, the reflection factor of an electromagnetic wave is 1 that is, permeability is almost 0, and the effective performance as a short circuit machine (short plunger) is demonstrated by wide band width of face of no less than 20GHz. The account of the average also of drawing 7 and the reflection property (transparency property) of the electromagnetic wave in conventional short circuit **** 80 (short plunger which prepared the slit) shown in 8 was carried out as an example of comparison (refer to dashed line). In this case, although demonstrated most effectively at about 4GHz bandwidth (48-52GHz), as compared with the case of the short circuit machine 50 of this example which used the dielectric multilayer substrate, as for the performance as a shorting bar (short plunger), it turns out that the effective bandwidth as a short circuit machine (short plunger) has only 1/5.
[0097] thus, the short circuit machine (short plunger) which has the function of the band elimination filter which reflects the electromagnetic wave of a desired frequency band alternatively for it to be markedly alike moreover by the low cost as compared with the conventional technology, and to have a large effective bandwidth has been realized, without preparing the slit which needs a high process tolerance
[0098]
[Effect of the Invention] the filter for the dielectric multilayer substrate which according to this invention does not need to prepare the slit as which a very high process tolerance is required, and can be manufactured easily, microwave, and/or millimeter waves -- the manufacture method of them is offered
[0099] And if this dielectric multilayer substrate is used, the filter which can be made to penetrate or reflect the electromagnetic wave of a large frequency band alternatively can be created easily.
[0100] The filter using this dielectric multilayer substrate is preferably used as a short circuit machine (short plunger) which has the function of the band elimination filter (BRF:band rejection filter) which reflects the electromagnetic wave of a desired frequency band alternatively especially.